

SECRETARY WILSON ON FORESTRY.

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EFFECT OF FORESTRY
ON WATER SUPPLY.



THE PRACTICAL IN
FORESTRY.

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AN EXAMPLE OF SCIENTIFIC FORESTRY.

Economic Tree Planting in Kansas, Showing a Twenty-five year old Plantation of White Maple, near Manhattan, Serving as Windbreak and Source of Fuel.

THE FORESTER.

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What Forestry Means to the United States.

BY THE SECRETARY OF AGRICULTURE.

Among the great questions which bear directly both on the present prosperity of the United States and upon the future wealth and happiness of its people, forestry occupies a conspicuous place. To realize how prominent is its part among the problems of our national life it is only necessary to glance at its relation to the great industries of the country. Practically all manufactures are tributary, directly or indirectly, to the forest. The great business of transportation would be wholly impossible without it. A failure of timber in mining is often as disastrous as the failure of the ore-body itself. Even Agriculture, without the products of the forest, would be everywhere seriously crippled and in many parts of the country almost absolutely impossible. In a word, forestry is interwoven with the whole of our present activity as a nation.

The public mind has not, however, always been awake to the vital connection of forestry with our national welfare, nor has it always understood what the term itself denotes. To quote from an article in the last year-book of the Department of Agriculture:

"The meaning of the word 'forestry' changes in the public mind from decade to decade. The change is due not only to a better understanding of the subjects with which forestry deals, but also to a radical difference in the way forestry is esteemed. The progress of the knowledge of any subject is almost always accompanied by a change in the point of view from which that subject is regarded. Thus, electricity, from being a matter of purely scientific curiosity, has made its way in public thought to the position of one of the foremost industrial forces of the time, with the promise of such future usefulness that whatever relates to it finds a ready hearing. In somewhat the same way forestry is gradually winning a better standing and a larger place in the consideration of the people.

"At first forestry was understood to relate to trees; and it was not until recently that it began to be seen that it has far less to do with individual trees than with forests. At that time landscape work and forestry were completely confounded, nor even at this day is the distinction always clearly made. Street trees were supposed to be the special province of the forester, and even yet one of the great Eastern cities has a city forester, whose duties are not concerned with any forest land. This point of view has served a most useful purpose, it is true, in enlisting the countenance and support of very many persons whose interest in forest matters, rightly so called, would have been small indeed, but it may fairly be questioned whether there has not been a counterbalancing loss of the good will and consideration of practical lumbermen and owners of forest land.

"Apart from the æsthetic point of view just referred to, a serious check to the progress of forestry, or, as this side of it might well be called, of conservative lumbering, was

the general praise given to European methods of forest management and the frequent and strenuous, but utterly impracticable, advice to apply them in the forest of North America. To very many of the men upon whom the introduction of forestry in the forest depended and still depends, this was a complete barrier, for it made forestry seem unworthy of even the most casual consideration. But these were mere temporary obstacles to a true understanding of forestry and marked what may have been inevitable stages of its progress. Another and a worthier point of view has been that of the effect of forests upon climate, a subject of which, it must be confessed, we know comparatively little. To-day this subject is largely replaced in general discussion by the effect of forests on water supply, with which we are better acquainted. This, at last, is one of the real and vital issues with which true forestry is concerned."

But it is only one of them. The vast material progress which, since 1865, has distinguished the United States among all the nations of the world, would never have been achieved without the great resources in timber which we have been able to command. In spite of the enormous development of the use of metals in this country, our material civilization is still distinctly founded on the use of wood. If we had not had an abundance of wood from the beginning of our life as a nation until the present day, the United States would not now be first in the family of nations in wealth and in food-producing power. Whether or not it is true that republics are ungrateful to their great men, it certainly is a fact that their citizens are careless of the resources to which their prosperity is due. That great wealth finally tends to prodigality is an axiom in human nature, whose illustration can nowhere be found better than in the treatment of the forest resources of the United States by its citizens. It is not without interest to note that the first settlers in New England, with the vast stretches of unexplored wilderness before them, and a body of standing timber to draw upon whose amount they could not even reckon, took immediate steps to prohibit the waste of wood and the destruction of forests. It was only later, when a knowledge of the vastness of their timber resources led to recklessness, that the indiscriminate destruction of forests began. Still later came the second effort toward forest protection, in which we are still engaged.

It has not been wholly due to recklessness or thoughtless haste to be rich that the destruction of vast areas of forests has occurred in the United States. Economic reasons have had immense influence and one of the chief of these is the question of taxes on timberland. Referring to the unbearable weight of the taxes too often assessed on uncut or cut-over timberlands, the article quoted above says with entire justice:

"Hundreds of thousands of acres in the white-pine region, notably in Pennsylvania, and in Michigan, Wisconsin and Minnesota, have been cut over, abandoned, sold for taxes, and finally reduced by fire to a useless wilderness because of the shortsighted policy of heavy taxation. To lay heavy taxes on timber land is to set a premium on forest destruction, a premium that is doing more than any other single factor to hinder the spread of conservative lumbering among the owners of large bodies of timber land. Not only does this policy lead to the destruction of the forest, but it reduces eventually the sums raised by taxation. Devastated lands are valueless, and therefore can not be assessed at anything like their former rates. Then follows a reduction in the sums raised, and then a higher tax rate for the rest of the real property in the region; and so, by a roundabout but certain road, the chickens come home to roost, and the men who invited the destruction of the timber that should have made and kept them prosperous have to pay some part at least of the penalty of their shortsightedness.

"It does not change such facts as these to explain how the heavy taxes happened to be assessed. It is true that the temptation to tax nonresident owners is very great; that companies are often made to suffer for their local unpopularity, and that the burden of building and maintaining roads and bridges and court-houses in sparsely settled countries bears heavily on their people. But when every allowance has been made, the fact still remains that heavy taxes are responsible for the barrenness of thousands of

square miles which should never have ceased to be productive, and which must now lie fallow for many decades before they can be counted again among the wealth-making assets of the nation. It is not greatly to the interest of any man to protect such wastes, and so fire runs over them year after year, and their possible utility recedes further and further into the future."

This instance of the destructive agencies which are constantly reducing the area of productive forests is but a single example chosen from very many because it is less widely known. Forest fires, sheep grazing without proper safeguards, and the lack of a general knowledge as to what is possible in forestry are among the other great influences at work for harm. It is only of recent years that the conservative forces have begun to make themselves felt, and even yet they are by no means up to the level of their task, albeit steadily gaining. The conflict against the forces of forest destruction, with its enormous attendant evil to the nation, as opposed to conservative forestry, with the security it brings is worthy of the best interest and effort of every patriotic citizen.

For many years a small body of earnest men has been calling public attention to the urgent need of action for the preservation of forests in this country, until at last they have convinced the people at large that something needs to be done. At first there was a general impulse to ridicule the warnings and appeals of the American Forestry Association, to which in the end nearly all of these men came to belong. There was a reason for this state of affairs, for at first much that was written and said by over-enthusiastic friends of forestry was less practical and less directly applicable to the American forest problem than it should have been. But this tendency gradually disappeared before a better understanding of the problem by the friends of forestry, and a truer conception of the real purpose of the forest reformers by the lumbermen and the general public.

At present there is scarcely an intelligent American who is not in accord with the aims of the American Forestry Association. The time has evidently come when this Association, strengthened by the approbation of its objects now practically universal among our people, is about to make its beneficent influence much more widely and practically effective than ever before. Indeed all the agencies at work for the perpetuation of our forests are taking on new vigor, forest schools are springing up here and there, young men in numbers are turning their eyes toward forestry as a profession, and the general desire of the people, expressed through their representatives in Congress, is giving greater efficiency, year by year, to the work of forest education and right forest management on the ground. Among the forces on the side of progress the Department of Agriculture has long held, and still maintains, an honorable place.

Protection, chiefly against winds, floods, and drought, and the continuous production of wood, are the prime objects of forestry. To review in detail what forestry means to the United States would be to discuss the value to the nation of practically all its industries, for practically all of them use wood, and the comfort and prosperity of practically all its people, for we all use wood in ways we could very ill afford to spare. In addition the lumber, tanning, and wood-working industries, with their enormous annual output, would have to be specially considered. Forestry means the preservation and perpetuation of all these, just as continued forest destruction means their injury or their complete decay. But my limits will not permit me to dwell upon this phase of the subject. I pass now to a sphere of forest influence with which, as a farmer, I have had special opportunity to become acquainted. It may serve as an example of how closely forestry may be related to the men of a widely separate calling.

The interest of the farmer in forestry is a vital one, and by no means confined to the effect of great forest masses on the climate or on the distribution of the rainfall. Such bodies of forest usually lie apart from the chief farming regions, and their influence, however great it may be, and however generally it may be acknowledged, is far less tangible and convincing to the farmer than the things he can see and handle on his own

farm. I have no desire to belittle the vast utility of mountain forests, or to slight what may fairly be called the appalling need of conservative forest management throughout all the great forest areas of the country. These are matters of the first importance to the prosperity and happiness of us all, and it would be difficult to give them undue weight in any consideration of the great resources of the United States. In this paper, however, I must take them for granted and go on to consider briefly what interest the farmer has in forestry on his own farm.

There being, according to the census of 1890, more than 200,000,000 acres of forest in farms, it appears at once that this is, in the aggregate, a very great question for the farmers in wooded regions. As we shall see, it is no less important for the farmer living where all the trees have been planted by the hand of man.

A farmer who has a woodlot on his farm is interested in it in three ways. If he lives in a treeless country the protection of his house, his stock, and his growing crops against freezing and drying winds is of the very first consequence. It may be objected that this matter of windbreaks and shelterbelts is outside the domain of forestry, but the objection is not well taken. Forestry deals with forest trees in their relation to the material welfare of the human race. Whether the service they yield to man is rendered in fuel, timber, or protection does not affect the definition. Nor is it material whether the protection given is against floods, snowslides, blizzards, or drying winds. All these are within the province of forestry.

The farmer in a treeless region is deeply concerned, with the presence or absence of windbrakes and shelterbelts on his farm, not only because of the essential necessity of the protection they afford, but for another and most practical reason as well. It has been ascertained by the estimates of competent men on the ground that the average value of a farm, in certain of our treeless States, is actually increased about ten per cent. by the presence of good plantations.

The farmer, where trees grow unplanted, is likewise concerned in the protection which his woodlot gives, when he is fortunate enough to have it rightly placed, but his dependence on shelter is far less than that of the man in the treeless West. Still it is often enough to make the difference between comfort and discomfort, or sometimes between prosperity and want.

In the second place the farmer is interested in forestry as a producer of wood. The planted grove or windbreak of the prairie farmer not only supplies him with part or all of his fuel, with fence posts, and with wood for other uses about the farm, just as the woodlot does more abundantly for the farmer of the wooded regions, but it may contribute, through the sale of any of these items, ready cash to no inconsiderable amount. On many farms in the East the products of the woodlot, such as ties, posts, and cordwood, bring in a very large per cent. of the yearly revenue in money. It is by no means uncommon for a farmer, to whom his cultivated fields would give but a bare living, to be lifted into comparative ease by the produce of his woodlot. For the Eastern farmer it is always harder to get ready cash than to raise produce for the subsistence of himself, his family, and his stock, and it is just here that his woodlot, rightly handled, is often his main reliance. It is hardly too much to say that under intelligent handling it might always be made so.

In the third place, the farmer is concerned in forestry because he is a purchaser of timber. The price of his agricultural machinery and of nearly all his tools is affected by the progressive destruction of our forests. His house and barn, in the vast majority of cases, are built of purchased timber and roofed with shingles which have cost him money. His produce goes to market in wooden cars hauled over wooden sleepers. His cradle and his coffin are of wood. It behooves him, scarcely less than the lumberman, and far more than many other classes of the community, to see to it that the forests of our country are not destroyed. To that end the American Forestry Association is an instrument sharpened and ready for his use. This Association, if I may be allowed a

word about an organization of which I am an officer, and in whose work I am deeply interested, has for its chief objects to bring about a wise and more conservative treatment of the forest resources of this continent, to diffuse information concerning the conservative management and the renewal of forests, and to encourage the intelligent planting of trees. It is therefore broad enough in scope rightly to be called American, and its purposes may be justly said to be patriotic, in the true sense of that strong word.

In addition to the general interest of the farmer in forestry, and even more vital to his welfare, is the condition of the plantations or the woodlot on his own farm. Forestry is a subject not to be mastered in a day, and yet the woodlot and the plantation should have all the assistance that common sense and training together can give. Such assistance the Department of Agriculture offers to the farmer for the asking.

JAMES WILSON.

The Practical in Forestry.

A Paper on the Blending of Ideas regarding Lumbering, Forest Conservation and Reforestation.

FROM THE LUMBERMAN'S STANDPOINT.

There is an ancient platitude which is often heard, that "There are two sides to every question, the right and the wrong;" but in the question and the study of forestry there are four, viz: the right, the wrong, the theoretical and the practical. Perchance the four may mingle one into the other three, or the three into the one, but it is my intention to expound the practical factor in the great, important, and far-reaching study of forestry in the United States, or, more precisely, on the Pacific Coast.

In the Oriental countries the picturesque, artistic style of the garments donned by the natives impresses the average traveler as most pleasing to his vision. He wonders at the grace, the ease of movement, the subtleness and the many evidently desirable characteristics of the costumes worn; and so, departing from the country of his observations, he is impressed by the ensemble but overlooks the other aspect of the consideration. Through the vista of his romantic conceptions he forgets to study the practical, and deeper evidences which affect the wearer of those habiliments of the past. So it is likely to be with the stu-

dent of the theoretical conditions of the forest movement.

I would not have it understood for a single moment that I am not heartily in favor of the preservation of our forests and the conservation of our waters, but the function of this paper is to dwell on the practical avenue of the consideration: to view forest preservation from the standpoint of the operating lumbermen of the Pacific Coast and of California in particular.

Certainly the numbers and the status of the manufacturers of Redwood lumber deserve and demand attention in the formulation of the acts of this Association which is so nobly championing the cause of forest preservation all over the United States. It is only right; it is only just, for the strictures of a despotism alone would forbid and repress the arguments, *pro et con*, on any subject under consideration. In truth it is to assist and further the efforts of all of us who are so deeply interested in the forest matters of moment, that I have compiled this paper.

I believe it best to throw as much light as my feeble pen will permit upon the

possible obstacles in the path of the future onward march of progress, leading toward and to the goal of successful forest measures, so that we may be strong enough and wise enough to avoid the stumbling blocks and remove the boulders of all opposition. We shall thus be able to leave for our posterity a grand inheritance—the sublime forests which the good Father Protector has given us in all their primeval grandeur. Let us all, as many are now doing, labor to preserve or reproduce, by decades of wise forest enactments, this generous, this beneficent gift.

We all love to linger, as true worshippers of Nature, in the restful calm of the vast forests, indulging in an almost Druidical reverence of the mighty giants of the Sequoia groves; listening to the music of the waving branches which sang their songs of creation long before the Infant's wail, from His cradle in the manger, heralded the advent of a new faith. We, everyone of us, delay our hurrying footsteps to draw fancy sketches of all of Nature's loveliness and drain to the full our flagon of poetic inspiration, while rejoicing that the world has been moulded in so beautiful a conception. But in our peaceful wanderings we never encounter the importunate exactions of the tax collector, or discover, on a bright and sunny morning, that our notes have matured at the bank. We theorize and sup at the board of fancy; but the lumberman, the owner of these same preserves, while feeling and appreciating the natural beauties of his possessions, has with him the omnipresent sense of business responsibility. He has paid with funds and labor, and, to preserve his integrity and status as a man, must open some avenue toward the successful future possession of a new dollar for an old one.

There may exist a misapprehension that the lumbermen of the Pacific Coast are opposed to any efforts being made to preserve the forests, because of a possible encroachment on their rights as lumbermen. A thorough canvass of the larger mill operatives and holders of extensive timber lands in California failed to discover a single individual or company in opposi-

tion to a wise supervision of timber properties. But the character of such methods of preservation must be wise and practically planned. Some of the purely theoretical may be wise, but the average mill-owner has had considerable experience with the holder of theoretical ideas on this subject and looks with suspicion and disfavor upon the "unhappy dreamers," as one of the prominent lumbermen described the type.

But let one fact be understood and appreciated to the greatest extent: the California lumberman recognizes with all of us, that only with the proper care of the forests of this State and of the Coast, under a wise preservative policy, conservative, yet radical, can our water supply of the future be assured, and the prosperity of the agricultural classes remain a comparative certainty. He continues in this line of thought and reasons rightly that, with the well-being of the latter class, will come the growth, the advancement and the prosperity of the commercial, the mercantile, the manufacturing and the social divisions of the commonwealth. Knowing these truisms and appreciating their great bearing upon the welfare of the Golden State, the lumber manufacturers and the possessors of the timber lands are heartily in support of the preservation of our State and Coast forests.

Now for the direct consideration of the practical aspect of the present question of forestry. For the sake of brevity, I will divide the subject into two sections: First, the difficulties opposing forest regulations on this Coast; and secondly, what measures will meet with the sanction of the lumber manufacturing interests.

The first difficulty met with is the enormous amount of the standing timber of to-day in this State, since the lumberman is prone to think only of the present and not of the possibly exacting demands of the future. It has been found, also, that when the mighty mammoths of the forest have been felled, there appears and spreads over the lands so cleared a dense undergrowth of the wild blackberry, with which is mingled the purple *Ceanothus*, colloquially known as the California lilac.

This rapidly growing shrub affords, in my opinion, a far better means of conservation for the waters than did the members of the original grove of Sequoias, since in many, if not all, of the localities, the thicket is so dense that it prohibits the passage of man. This feature has the evident tendency to cause the mill and forest landowner to set aside all arguments relative to the non-conservation of the waters through the clearing of these forest lands.

But what most heavily impresses the lumberman is the fact that suitable wardens, in their minds, cannot be selected. Suppose, for example, that a supervisor should be selected by the Federal or State governments. Either of these would be prone to follow their present doctrines of economy. The warden would not receive a sufficient salary. He would thus be open to corruption in nine cases out of ten and with his fingers closely grasping a gold piece, he would find the occasion timely for a visit to a distant locality when an infraction of the forest laws was in prospect.

This absence of trust in the integrity of the appointee is to be deplored, but it is natural on the part of the millman, and makes the latter view with suspicion all endeavors to secure possible enactments for re-forestation and water conservation and the furtherance of the same through the acts of wardens. This statement may seem too sweeping, but this idea is supported by the remarks of many of the authorities who know of what they speak, from years of experience in the manufacture of redwood products. High wages seem an impossibility: without which comes the almost certain liability of corruption of the State and Federal officers.

In the consideration of the idea of governmental selection of the timber to be felled there enters the element of wisdom. This characteristic is an absolute essential. Bohemia has proven the success of similar schemes of forest supervision by the government, but the conditions confronting the warden here in California are vastly different. Let the timber of a certain gulch be selected for exploitation. The company constructs a logging

way, it may be either a skid road or a railroad, at considerable expense, and, for remuneration, this company depends upon the receipt of timber in large enough quantities and of medium qualities from the affected district. Here is where the wisdom on the part of the warden proves a necessity. Should he subject the timber to an unwise and too exacting supervision, the company would necessarily suffer a heavy loss on their logging-road outlay. From that occasion the suffering lumberman would seize every means in his power to circumvent the functions of the supervising government agent. But if the latter be wise and possessed of a thorough knowledge of his profession (for it must be a profession), the company is conciliated and a good effect accomplished. Under all other conditions save this single welcome one, the warden encourages the furtherance of a vast amount of evil, rather than of good.

The greatest danger feared by the mill owner is that governmental action will not be uniform or accurately adjusted to the varying conditions of timber localities. To be successful and of permanent benefit, the Pine, the Spruce, the Fir and the Redwood properties must be superintended jointly and wisely on a thoroughly unbiased plan or else the results will be nil.

Relative to the proposal of the governmental purchase of cut-over lands, the same does not meet with approval of the Redwood lumbermen. In the Pacific Northwest the conditions may be more favorable, since the mills are owned by individuals who purchase the logs from others. But the Redwood manufacturers own their own lands and accomplish their individual logging for their own plants. These companies will not dispose of their cut-over lands since, in the majority of cases, their logging operations extend back from adjacent rivers tributary to the ocean and the right of way over these lands determines the increments of expense and time. Again, should the companies dispose of their lands near these rivers, the occupation of such would be dangerous to the purchasers because of the frequency of log-jams and the subsequent flooding of

the adjacent properties with a possible, yes, probable, accompaniment of heavy loss of life. In many instances, companies have refused a fair price for their cut-over lands to avoid legal complications over this latter feature, and the inconveniences of the loss of the right-of-way for logging operations.

These are in part the fundamental objections on the part of the mill operators. Now for the measures which would receive the support of the lumbermen.

The primal essential in the minds of all is the absolute need of a thorough system of forest education which will simultaneously embody the essentials of the theoretical and the practical. This would insure a capable foundation for the general and specific labors of forest culture and preservation.

Secondly.—Under the supervision of either the State or the Federal governments, should they assume the direction of forest movements, a sufficient salary must emphatically accompany the position of forester. This wise feature would nullify all attempts at warden corruption by the efforts of the interested lumberman.

Third.—The political element in the selection of forest supervisors must, first, last, and for all time, be eliminated, and a thorough civil service procedure be inaugurated in the selection of these officials. The technical qualifications, allied with the practical, should be the basis of appointment, and not because the warden is a close business associate of the head of the government, either State or Federal.

Fourth.—The enactments designed to insure wise forestry supervision must be equal and equitable for the various timber species since the warring Redwood and Pine interests will never suffer any element or circumstance to give one iota of weighty influence to either, to the detriment of the other.

Fifth.—The idea of governmental purchase of cut-over forest lands may just as well be relegated to the rear of forest possibilities on account of the evident opposition of the lumbermen. Perhaps some few companies in isolated cases might favorably entertain the contemplated pur-

chase, but the important majority would not.

In the furtherance of these ideas the lumbermen of California and of the Pacific Coast will undoubtedly give their individual and united support. Each and every one of them is heart and soul with the movement, provided no foolish, unwise, ill-advised obstacle is placed in the way of the successful lumbering operations of their future. What they most favor, is the Bohemian policy of gradual re-forestation, which the authorities of that country have followed for decades. There every tree cut into fagots for the warmth of the poor and lowly is immediately replaced by small seedlings, transplanted from the nursery plot elsewhere. In 250 years (the minimum life allotted to the wonderful forests of Humboldt County) the lumberman feels a goodly account would be rendered by the saplings planted in this century.

WALLACE W. EVERETT,
San Francisco, Cal.

Forests for the Rich Only.

The present agitation for street and roadside tree planting draws attention to the appreciation of such plans in England. A recent traveler there, describing the road to Warwick, says:

"There are fine trees all along, many Oaks, some Poplars rising aloft, but especially tall and stately Elms; these are so plentiful that there is a local name for them, 'Warwickshire weeds.' Except in the parks of the rich people, however, there are no woods, no forests, no 'belts' of 'timber'; the trees rise out of the hedgegrows, stand beside the road, and gather about the houses. Sometimes there is an avenue of them."

The statement that there are no forests except for the rich may be regarded as "a word to the wise" to consider in time the advisability of national parks for the people in America.

The result of the efforts of Minnesota and North Carolina to secure the establishment of national parks will be watched with interest throughout the United States.

Effect of Forests on Water Supply.

II.—INVESTIGATIONS REGARDING CAPILLARY ACTION AND THE EFFECT OF FOREST COVER AS RELATED TO WATER SUPPLY.

The mechanics of granular soils present some particularly interesting features. It can readily be demonstrated that, if the granules are true spheres and of one uniform diameter, the voids form one constant percentage of the total cubical contents, irrespective of the actual diameter of the spheres, and also that the area of passages between the spheres bears a constant ratio to the area of the circumscribing cross section, irrespective of diameter. This is a property of uniformity of size. By mixing different sizes together in such proportions that each succeeding smaller size enters the interstices of the preceding larger grains of soil may be made impervious to water, save by capillary action. This feature of mixtures will frequently explain the imperviousness of stream beds in sandy gravel. Although the voids and water passages bear a constant ratio to the total volumes and areas with grains of uniform size, the rate of the passage of water is higher the larger the grains. With very minute grains the passages become capillaries entirely and gravitation is overcome.

Capillary action is one of surface tension. Imagine a membrane enclosing each grain and stretched thereon. The tension of this imaginary membrane is analogous to surface tension. The surface tension increases with decrease of radius. The sharper the curvature the greater the tension. When neighboring interstitial spaces are filled with water to a greater or less degree surfaces or films of sharper or flatter curvature are produced. The surfaces are not in equilibrium and a movement from the flat to the sharper curves takes place, and continues until, by re-adjustment of the curves, equilibrium is established.

This is the nature of capillary action; it takes place in all directions according to

the surrounding conditions. In soils the conditions are usually such that the action is upward and opposed to gravity. Evaporation at the ground surface depletes the interstitial spaces, the films around the grains grow sharper of curvature and a movement takes place toward them from the lower interstices refilling the upper. Forests reduce surface evaporation and retard the capillary depletion of ground water. In chalk the limit of capillary action exceeds 16 feet. In sandy soils one and a half feet has been found to be an extreme. In very open coarse material the limit may be but a few inches.

The rate of percolation is affected by the temperature. The viscosity, or internal friction, of water increases with decrease of temperature. Assuming the viscosity at 32° Fahrenheit to be 100, the viscosity at 77° is found to be 50; at 86°, 45; and at 112°, 31. The viscosity of gases, contrary to that of fluids, increases with increase of temperature and as air is frequently used in making permeability tests of soils grave errors are liable to be introduced, unless these opposite characteristics are duly accounted for.

Tests at ten German forest stations show that the general effect of forests is to raise the soil temperatures during the cold months and lower them during the warm months. This has the effect of facilitating percolation during the rainy periods and retarding capillary upward action during the warm months when little rain falls. The surface tension of water is also lowered by increase of temperature, causing less capillary resistance to gravitation and increasing percolation.

The rate or velocity of percolation is very variable. It varies with every soil, from no movement whatever, to over 100 feet per hour. Each soil is more or less a law unto itself and must be studied by it-

self if exact results are sought. There is one great distinction between water flowing freely in open channels or pipes of measurable size, and percolating water. The flow of the former is a function of the square root of the head, while the flow of water traversing minute passages varies directly with the head.

Capacity, as previously stated, is the quantity of water which can be introduced into a dry soil. It is usually expressed as a percentage of the soil volume. The total quantity that a soil is capable of imbibing is termed its maximum capacity. This quantity is divisible into two parts: the one removable by drainage, the other by evaporation. This latter part is again sub-divisible into two parts, one brought to the surface by capillary action and there evaporated; the other almost permanently retained within the soil, requiring for its removal long continued applications of heat. This part is termed hygroscopic moisture.

German authorities have determined the maximum capacities of various soils to range from $46\frac{1}{2}$ per cent. for quartz sand to $70\frac{1}{2}$ per cent. for humus, and the minimum capacity or water remaining after gravitation to range from 17 per cent. to 49 per cent. Of the minimum capacity the portion retained as hygroscopic moisture has been determined by Longbridge, of the California Experiment Station, to range from less than 1 per cent. for sand to $14\frac{1}{2}$ per cent. for clays, these percentages being referred to maximum capacity. The wide range in the figures serves to illustrate the necessity of experimenting directly with any soil under consideration if exact data are required.

Of the different capacities the hydraulic engineer is more particularly concerned in that which relates to the quantity that may be drained out; on the other hand, the arboriculturist is much interested in the amount of capillary water from which plant life largely draws its supply. An authority on effects of forest cover (Dr. E. Ebermayer), found that, except for the top layers, unshaded soil had more capacity than shaded soil. Taken as a whole, however, for a depth of 32 inches

he found the soil under young Spruce trees to have 2 per cent. and under old Spruce trees $7\frac{1}{2}$ per cent. greater capacity than naked soil. These are very instructive figures.

THE "FOREST FLOOR."

It is manifest that the character of the forest floor, *i. e.*, the litter covering the ground, must have a marked effect upon the absorption of water. Wollny found as a result of his experiments that under a grass cover there was 50 per cent. less percolation than in naked soil. He found a litter of Oak leaves to pass 42 to 74 per cent. of the rainfall, Spruce litter 46 to 78 per cent., Pine needles 52 to 69 per cent., Moss 39 to 53 per cent. The variations are due to varying thickness of cover. The shallower the cover the less the soil imbibed, for the obvious reason that the water was presented to it too quickly. Again, considering the Rothamsted tests, which gave the percolation of bare soil at from 45 to $47\frac{1}{2}$ per cent. of the rainfall, it will be seen that ordinary forest litter will pass more rainfall than the earth ordinarily imbibes. Consequently the cover will remain in a state of saturation for a greater or less period of time during which it will protect the ground from evaporation. A soil covering of humus, however, would allow little water to pass to the soil beneath. It would be beneficial in lessening the force of storm water, but otherwise would work a loss to ground storage. Ebermayer says that besides clay it is especially humus which imbibes almost all precipitation and gives up little water to the ground below; and he adds that if the earth were covered by a humus soil of one meter in depth, subterranean drainage would be so slight that springs would be scanty and continuously flowing springs absent.

The forest floor is a most important factor in retarding storm-water and protecting the earth from erosion. This is particularly true on steep mountain slopes. The destruction of forest litter by fire, sheep, or deforestation is little short of a national calamity. Each rain washes away tons upon tons of loam, sand and

rocks to cover up the lower lands—a double disaster. The fertile soil of the higher lands is destroyed, the fertile soil of the lower lands is buried under a waste of debris.

There is one other subject to consider—evaporation. Under this head will be included transpiration from foliage. Temperature and wind are the chief controlling elements in evaporation. Woods lower temperature and reduce the velocity of the wind. It is to be expected, therefore, that evaporation in woods would be much smaller than in the open. Such is found to be actually the case. The observations of sixteen forest stations in Germany show a marked saving effected by the woods. Of the rainfall an average of 42 per cent. was evaporated in the open and 24 per cent. in the forest—a clear saving of 18 per cent. The evaporation from water surfaces in woods was found to be about 38 per cent. of that from water surfaces in the open.

As an offset to the saving in the evaporation comes the moisture transpired through the foliage, and that retained in the substance of the tree. The transpiration computed by various observers ranges from an equivalent rainfall of one-quarter inch per annum for four-year old Firs, up to 15 inches for cereals and 37 inches for grasses. Forests of mixed growth transpire about $6\frac{1}{2}$ inches. According to observations at the Austrian stations, deciduous trees transpire during the period of vegetation 500 to 1,000 pounds of water per pound of dry leaves, and the coniferous from 75 to 200 pounds. (This suggests the natural selection of conifers for our own mountain slopes.)

One remark of Hohnel, regarding the Austrian observations, is very suggestive. He says: "A plant will transpire in proportion to the amount of water which is at its disposal." This remark serves to illustrate the point that willows and other water-loving growths along the streams consume more water than they save. There is a coincidence between the fall and rise of the Los Angeles river and the budding and fall of the willow leaves.

It is estimated that a coniferous forest

will transpire 8 per cent. of a total rainfall of 20 inches and a Beech forest 48 per cent. The amount of water annually absorbed into the structure of the trees has been estimated as ranging from 19 to 25 per cent. of the weight of the wood, and 54 to 65 per cent. of the weight of the leaves.

The hard wood deciduous trees absorb 38 to 45 per cent., the soft wood 45 to 55 per cent., and the conifers 52 to 65 per cent. These quantities are equivalent to about 2 per cent. of the water required for transpiration and are in addition thereto.

On the basis of these figures a coniferous forest, which of all forest makes the best showing, will give a net increase to the ground storage of about 10 per cent. of the rainfall, to say nothing of its effect upon increased conductivity of the soil and the storm water held back so that the earth has better time to drink its fill, in themselves important items.

The State of New Jersey has wisely expended large sums in measuring the flows of its streams and in ascertaining the physical elements controlling these flows. The Engineer of that State, in language free from hesitancy, says, after long labors and study on the subject:

"We believe it will be helpful to the cause of forestry in the future if the effects of forests upon stream-flow are more carefully and accurately stated. Their effect in holding and preserving the soil upon slopes is very well known, and besides this they create a mass of humus and absorbent matter upon the surface which has an effect upon stream-flow, and the general evils resulting from deforestation are a matter of careful observation and record, so that too much stress cannot be laid upon the desirability of preserving a proper area of forest.

"The study of the streams shows that in every case, almost, it is the watershed on which is the largest proportion of forest which shows the largest flow from ground-water." This is particularly pertinent to the present discussion.

H. HAWGOOD,
M. Inst. C. E.,
Los Angeles, Cal.

Changing Mt. Rainier's Boundaries.

**Official Approval of the Suggestions made by An Authority through
The Forester.**

An excerpt from the annual report of the Commissioner of the General Land Office, recommending to the Secretary of the Interior the extension of the Mount Rainier National Park, will be of especial interest to readers of *THE FORESTER*, in that the recommendations made by Mr. Bailey Willis, in the leading article of the May issue of *THE FORESTER* are officially approved by the head of the Government Forest Reserve service.

In the section of the report devoted to the care of the National Forest Reserves under his supervision, the Commissioner speaks as follows:

"One of the most important measures taken during the past year in connection with forest reservations was the action of Congress in withdrawing from the Mount Rainier Forest Reserve a portion of the region immediately surrounding Mount Rainier and setting it apart as a national park.

"The peculiar features of this region demand protection of a widely different and much more stringent nature than that afforded a forest reservation. The forests that clothe the slope and foothills of Mount Rainier require, as great regulators of floods, to be preserved absolutely untouched, while the fact of the presence of arctic animals in that region calls for extraordinary measures to insure to them proper protection.

"The importance attaching to effective measures to preserve these arctic forms of life was strikingly set forth in the memorial presented to the United States Senate from committees appointed by several of the scientific societies of the United States, which reads on this point as follows:

"But Mount Tacoma (Mount Rainier) is single not merely because it is superbly majestic; it is an arctic island in a temperate zone. In a bygone age an arctic climate prevailed over the Northwest and

glaciers covered the Cascade Range. Arctic animals and arctic plants then lived throughout the region. As the climate became milder and glaciers melted, the creatures of the cold climate were limited in their geographic range to the districts of the shrinking glaciers. On the great peak the glaciers linger still. They give to it its greatest beauty. They are themselves magnificent, and with them survives a colony of arctic animals and plants which cannot exist in the temperate climate of the less lofty mountains. These arctic forms are as effectually isolated as shipwrecked sailors on an island in midocean. There is no refuge for them beyond their haunts on ice-bound cliffs. But even there the birds and animals are no longer safe from the keen sportsman, and the few survivors must soon be exterminated unless protected by the Government in a national park."

"The necessity of having this unique peak and its environs preserved in a state of nature has for years attracted much attention, not only in this country but abroad, and the matter of setting it apart as a national park has long been one of international interest, eminent scientists of England and Germany being among the promoters of the move.

"In view of the great importance thus attaching to the subject, I regret to report that the area set apart fails to embrace all of the features of that region which it is desirable to have included. Certain districts have been omitted which belong more rightly within a national park than to a forest reserve, and as such should not be left without the protection of the park.

"Upon this point the views of Mr. Bailey Willis, of the Geological Survey, are of especial value. In an article in the May, 1899, issue of *THE FORESTER*, compiled partly from official data, Mr. Willis states as follows:

"The boundaries to the park as now established by law are not well considered for its future development. They are too limited. They fail to include districts whose scenic aspects are essential to the unity of the park, and whose features should not be left outside of its protection. This is most especially true of the western limit, and is to some extent true of the northern and southern bounds."

After quoting further, at considerable

length, from the article in *THE FORESTER*, concluding with the suggestions offered by Mr. Willis, the Commissioner sums up the matter in these very complimentary words:

"From all the data available upon the subject, I am of the opinion that I can not do better than indorse the recommendation referred to; and I accordingly recommend that the limits of the park as now established be changed to conform to the boundaries here suggested."

In the Southern Alleghenies.

Public Interest in the Establishment of a "National Southern Park and Forest and Game Preserve in Western North Carolina."

The Parks and Forestry Committee of the Asheville Board of Trade has taken the initiative in calling an interstate meeting at Asheville, November 22, to form an association and take practical steps for consummating the plan for a great forest preserve in the wild mountain regions of that state. It is aimed to bring the matter before Congress with a popular request for a commission to inquire into the feasibility of a National Southern Park in North Carolina. A large petition has been signed and the committee is assured of the aid of the state representatives and of many influential citizens who have long favored the movement. Its importance to the South and to the Nation is claimed to be of the first magnitude, as the committee expects to prove in due time. The petition is addressed to Congress, and reads:

"The undersigned citizens and voters represent that in the mountain regions of western North Carolina there are great tracts of timber lands, blessed with a salubrity of climate that renders the country admirably adapted for health-seekers and tourists. This region, as yet comparatively little known, is threatened with the denudation of its forests by lumbering and other enterprises. The exceeding beauty of the region, with its numerous springs and waterfalls, is dependent largely on the

protection of its trees. The increased activity in the various leather and woodworking industries has, however, given an impetus to the lumbering and tanning trades, and the destruction of these mountain forest lands is proceeding to a degree which makes it but a question of a short time when the ruin will be completed. Despoiled of the trees, the land will be comparatively useless. The resulting drying up of the springs and water-courses with attendant destructive floods will mark the irreparable damage done to this region unless legislative interference comes to its aid.

"The advantage to the nation at large in the establishment of a National Park in these mountains would be incalculable, from the fact of its readiness of access from all the large centers of trade, being within twenty-four hours journey, approximately, of New York, Chicago, Philadelphia, Boston, Indianapolis, etc. Your petitioners, undersigned, therefore, urge that measures be adopted looking to the protection of the region by the establishment of a National Park and Forest Reserve."

In furtherance of the project, the Park and Forestry Committee has sent out a handsome illustrated pamphlet, calling attention to the favorable opportunities now existing and emphasizing the consequences

of present neglect. The article in question says:

"An authority, Dr. C. A. Schenck, the eminent forester, in one of his interesting monographs asks, 'What is forestry?' and answers that no one seems to realize the scope and meaning of the term. Present conditions in the commercial and industrial world and in the Southern Alleghenies point to the rapid destruction of the virgin woods. The student of forestry is taught, and experience has proved the teaching to be true, that deforested land, particularly in a mountainous country, is the direct cause of destructive floods. The interference and absorption by the trees distributes and regulates the rainfall. In the dry season the trees protect and hold back the evaporation of the innumerable and minute tributaries to the springs, watercourses and rivers, thus regulating and preserving the water supply, without which regulation no region can long remain attractive or profitable.

"By the present system of lumber operations the virgin forests of the South bid fair to be soon destroyed. As the authority on the subject has indicated, if the forests are lumbered out rapidly as at present and if the fires are allowed to rage unchecked as at present, the same condition will speedily prevail in the South that now prevails in the lake states. There will not, it is claimed, be any sudden collapse of the lumber industry either South or North when the virgin forests are destroyed—if we are to permit them to be destroyed. The forests will be logged over three or four times; trees that are not worth taking now will be worth taking a few years hence, and so on. Gradual slackening of the industry will take place. It will slowly step down to the level which it occupies abroad. The mills will be supplied with short logs about ten inches through on an average. Lumber will be much more expensive as the supply will not equal the demand.

"Such seems the future of the forests and the lumber industry of the South. From an innate love of nature and sense of its beauty, every one regrets the seem-

ingly inevitable doom; the woodman, perhaps, more than the townsman.

"For the commonwealth, forestry as a permanent business is extremely desirable for climatic and economic reasons, the forests acting as a source of national health, steady water supply, and revenue from land often not fit for any other production. The people as a whole are interested in conservative, lasting forestry. The individual owning forests is solely interested in money-making forestry, conservative or destructive of forests as the case may be.

"It would be an impossible task to induce individuals to come to the aid of the country in regulating the lumbering and other operations which threaten its well-being, and hence the project of a Great Southern National Park in which the forests will be conserved and timber cutting be regulated on correct and economic principles by which means an object lesson will be given to the country and a strong argument offered why the forests throughout the land should be placed under forest wardens appointed by the State.

"The establishment of such a Southern National Park somewhere in the Blue Ridge or Great Smoky Mountains would mean the care of the forests and a stimulation of their growth, and regulating the cutting of the trees at maturity; the building of good roads through what are now inaccessible woods and mountain heights; the building of inns and hotels at convenient points, inducing a vastly increased travel from the North and South on the part of tourists and others; the more or less permanent residence of wealthy citizens who would be disposed to build homes in various localities in this region as they are already doing to some extent; the perpetuation of the beauty and healthfulness of the region and its elaboration in the way of making its most beautiful localities more accessible to the great mass of the people.

"It must not be supposed that lumbering or bark gathering would be materially interfered with. The Park project, if successful, would seek to conserve these industries. Under the present system they bid fair to hasten their own undoing by

the destructive and wasteful methods now in vogue. When all lumbering and bark gathering operations are under scientific control these businesses may be confident of a steady and regular supply of timber and bark. The individual will not be interfered with in his private rights. The lands suitable for the Park will be purchased at a valuation and the owners will receive in a lump sum more than they could hope to secure by selling off timber or bark.

"Pleasure and health seekers and tourists show a disposition to come in increasing numbers to this section of the South in the winter time and in the summer visitors from the South come to the mountains year after year, building homes and entering into the progress of the various communities.

"The attraction to these people is the healthful climate and the beauty of the region, and to this healthfulness and beauty the woods and forests are the prime contributors. With the destruction of the forests and the attendant evil effects upon the region, what has it to offer to attract visitors and others? In addition it must be remembered that the South has no park conducted on the same principles and aims as those in the North.

"The central character of the region gives the project of a Southern National Park attractiveness not only to the people of the South, but to the entire nation. Being within twenty-four hours from New York and the same length of time from the Gulf States the park would be a benefit to the greatest number of citizens of the United States."

The Influence of Forests Upon Storage Reservoirs.

Some Conditions Essential to the Maintenance of Streamflow and Water Conservation.

In an arid region, where irrigation is a necessity, and where the streams are intermittent in their flow, ranging in discharge from violent floods to trickling rivulets, storage reservoirs are essential for any considerable extension of the irrigated area.

Sites for reservoirs of large capacity are very scarce, where all conditions are right for the construction of safe dams, for the certain filling of the reservoirs, and for the convenient distribution of the water to lands suitable for its use. The scarcity of such sites renders it all the more essential that those which exist should be guarded from all influence tending to the destruction of their usefulness.

The mountain slopes of Southern California are more than ordinarily precipitous, and the denudation of these steep slopes of their forest growth by destructive fires, or by equally destructive bands of sheep, tends to loosen the surface soil and render it easily eroded, so that as the

vegetation of the mountains disappears, the streams become more torrential, and more heavily laden with debris. All this gravel, sand and soil is deposited in the bed of the reservoirs located in their path.

The result is to fill the space which should be devoted to the storage of water, thereby lessening its capacity.

The rapidity of this destruction of the reservoirs will depend somewhat upon their location; if they are in the mountains and have large watersheds of steep slopes they will more rapidly fill with coarse material. If they are nearer the plains on flatter slopes they will receive sand rolled along the bottom of the stream at their upper ends, and fine mud over the remainder of the area. Under these conditions they will fill less rapidly. The Sweetwater reservoir, near San Diego, is a type of the latter class, where conditions are most favorable. Recent measurements have shown that the deposit in the

reservoir during the eleven years of its existence has been about 5 per cent. of its total capacity. The filling has been almost directly as the depth of the water, being greatest at the dam, where the fine mud is 2 to 2½ feet deep, and is largely from the washings of plowed fields. Were this reservoir higher in the mountains the filling would be coarser and of greater volume, and if the reservoir were smaller, it would, of course, fill more rapidly.

Streams should always run clear, or nearly so, and their volume should be uniform throughout the year. The more perfectly the watersheds are covered with forest growth, decayed leaves, chapparal, and hardy grasses, the more nearly will this ideal condition of run-off be approached. The soil will be so bound with a network of roots that the rain and melted snow will pass off slowly without washing the surface, and the storage reservoirs will receive a minimum of detritus and a maximum of water.

This ideal condition, when perfectly attained, becomes in fact a substitute in large measure for storage reservoirs, and the soil itself of the mountain forests is converted into a great sponge, which constantly replenishes the springs and streams and keeps them in more uniform flow. Under such perfect conditions, reservoirs would be needed only to store the water of the rainy season for use in the Summer months, while the streams themselves would have higher irrigation duty in the dry seasons. A general extension of forest growth will make available many small reservoir sites that are now practically worthless because of the torrential nature of the streams, and their exposure to rapid destruction.

The essential, therefore, for the preservation of storage reservoirs and the general increase of stream flow is to maintain as dense a growth of vegetation upon the mountains as possible, and so patrol the sources of our streams as to prevent the spread of forest fires.

It is not well established that forests have any special influence in increasing the rainfall of a region, although the presumption

is that they have a slight tendency in that direction. But it is conceded that they have a very decided influence upon the temperature and humidity. In southern California we particularly need all such influence to counteract the effect of desert winds upon our orchards, and lessen evaporation upon our reservoirs.

The loss by evaporation in reservoirs, ranging as it does from ten to fifty per cent. of their capacity annually, according to their relative depth and surface area exposed, as well as their elevation above sea level, is one of the most important factors in estimating the duty of stored water. No other losses can compare with it, and anything which will lessen it will extend their usefulness. A general extension of the forests of the arid region must have marked effect in cooling the surrounding atmosphere, reducing the velocity and temperature of winds, increasing humidity, and lessening evaporation.

One of the encouraging features of the situation on the Pacific Slope is the rapidity with which all forest trees except the Redwood are being reproduced wherever they are protected from fires and from the ravages of sheep. Young Pines, Firs and Cedars spring up spontaneously where there is soil and moisture, and grow with vigor if let alone. This is in marked contrast to the sand plains of Wisconsin, Michigan and other more Eastern States, where the Pine forests once cut, seldom reproduce themselves, but are replaced by brambles and worthless brush. With proper care, therefore, the Western forests can be made a constant source of revenue, continually replenished.

A popular misconception of the intent and object of the Government in segregating forest reserves at the headwaters of our streams, is that they are to be forever left in a virgin state, and so lost to public utility. This opinion is widely held, and needs to be eradicated, for the reverse is really true.

The forests are not and should not be regarded as too immaculate for use. It is well recognized to be far better and safer to make them a source of lumber and firewood, utilizing the older trees and encour-

aging new growth, than to allow them to go to maturity and decay untouched. The guardians of the forest preserves should be required to gather seeds of trees and plants and sow them wherever they can be induced to grow. They should keep the young groves properly thinned out and have authority to sell saw-logs and firewood wherever the trees can be judiciously spared.

One of the important, though little considered, uses of the forest to the irrigator is the conversion of organic vegetable mold into nitrogenous plant-food. This is going on through the agency of the ever-present bacteria which re-convert the organic waste of the world into innocuous and useful mineral matter. Water filtering through the soil is constantly bearing these mineral nitrates into the streams and thence out upon the lands. Streams from treeless mountains lack these nitrogenous elements to a great degree, and the water has less fertility and is less valuable for irrigation.

The effect of the destruction of forests in mountainous regions is eloquently described by the eminent French political economist, Blanqui, in a memoir read before the Academy of Moral and Political Science of France, in 1843. He says, referring to the Alps of southern France:

"Signs of unparalleled destruction are visible in all the mountain zone, and the solitudes of those districts are assuming an indescribable character of sterility and desolation. The gradual destruction of the woods has, in a thousand localities, annihilated at once the springs and the fuel. The abuse of the right of pasturage and the felling of the woods have stripped the soil of all its grass and all its trees, and the scorching sun bakes it to the consistency of porphyry. When moistened by the rain, as it has neither support nor cohesion, it rolls down to the valleys, sometimes in floods resembling black, yellow, or reddish lava, sometimes in streams of pebbles, and even huge blocks of stone, which pour down with a frightful roar, and in their swift course exhibit the most convulsive movements. No tongue can give an adequate description of their devastations in one of those sud-

den floods which resemble in almost none of their phenomena the action of ordinary river water. They are now no longer overflowing brooks, but real seas, tumbling down in cataracts and rolling before them blocks of stone, which are hurled forward by the shock of waves like balls shot out by the explosion of gunpowder. A furious wind precedes the rushing water and announces its approach. Then comes a violent eruption, followed by a flow of muddy waves, and after a few hours all returns to the dreary silence which at periods of rest marks these abodes of desolation."

After years of agitation and discussion, the work of restoring the woods, and of controlling the floods and destructive erosion of the torrents, was undertaken by the French Government, at enormous cost, but with gratifying results, wherever carried out. The improvements consisted: (1) of the systematic planting of trees, grass and underbrush near the source of the streams to prevent the sudden and rapid collection of large quantities of rain and melted snow water. (2) The protection of the shores of the streams from undermining, and their beds from erosion, by the erection of small dams of masonry, loose rock, and brush, to diminish the grade and decrease the power of the water, to raise and widen the bed, and retain and store detritus. Many of these structures were made of green branches that were induced to take root and grow. (3) The terracing of the mountain slopes in a way to retard the run-off and guide the water into channels of light grade, where it could be conducted to the main streams without washing the soil. On one small watershed of less than 1,000 acres the Government expended \$125,000, but the benefits resulting immediately after completion were estimated at more than double that sum.

The Austrian and Swiss Governments have done a great deal of this work to restore the mountain watersheds to their original condition before the forests were destroyed, and great numbers of masonry dams have been erected to an extreme height, in one case in the gorge of Ferrina, Australian Tyrol, of 116 feet. These are

built exclusively for retaining débris and curbing the power of the torrents. The usual height of such structures, however, is about 25 feet, and they are placed as near to each other as the grade of the torrent necessitates. Their effect is incidentally to store water, as well as sand and gravel, for the voids in gravel reservoirs of that kind retain a considerable volume of water, which is given off gradually to the stream.

Such work could be done to advantage on every mountain stream in California, and I have no doubt that similar works will ultimately be undertaken in various parts of the arid West as a necessity, although it will require much agitation and united public opinion to secure appropriations from the general Government for such construction. The most important work in hand is to take measures for preventing further destruction, and thus

avoid the necessity for extensive correction of erosion in our mountain slopes and in our mountain streams. This costs less than the subsequent correction, and is more easily accomplished.

When this is well in hand, and when we have adopted practical measures for recovering our denuded mountain areas with plant growth and for protecting the forests we have left, a persistent effort should be directed toward the bridling of our torrents and the conversion of every mountain canyon into storage reservoirs. In this way only will our water supply be sensibly augmented and a large proportion of the wealth of water, annually wasting into the ocean or sinking in the deserts be retarded and retained for useful ends.

JAMES D. SCHUYLER,
Los Angeles, Cal.

For an International Congress.

Secretary of Agriculture Wilson has addressed to M. Thiebaut, Charge d'Affaires of France, French Embassy, the following note referring to the proposed international Congress of Forestry at the Paris Exposition: "Sir:—As president of the American Forestry Association, I have the honor to transmit herewith a copy of resolutions passed at the Columbus meeting of the Association with the request that you will have the kindness, through your Government, to transmit them to M. Meline."

It is hoped the Commission Internationale des Congres Agricoles, through its President, M. Meline, will call such a Congress at Paris during the Exposition.

This action is a part of the movement begun some time ago, chiefly through the instrumentality of Baron Herman, of the German Embassy, to bring about the compilation of forest statistics of all the countries in the world, on a uniform basis. The plan has already been approved also by the American Association for the Advancement of Science and the National Geographic Society.

Economic Tree Planting.

The effect of the sweeping winds on the prairies is shown in the picture of the single row of White Willow pollards, near Ames, Iowa. These trees have been permanently bent and their tops flattened by the prevailing southwestern winds.



The accompanying illustration is reproduced by permission from a photograph in the proposed exhibit of the United States Department of Agriculture at the Paris Exposition of 1900, showing the relation of Forestry to Agriculture.

THE FORESTER.

A MONTHLY MAGAZINE

DEVOTED TO ARBORICULTURE AND FORESTRY, THE CARE AND USE OF FORESTS
AND FOREST TREES, AND RELATED SUBJECTS.

THE OFFICIAL ORGAN OF

The American Forestry Association,

President Hon. JAMES WILSON,

Secretary of Agriculture.

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JOHN KEIM STAUFFER, EDITOR.

SPECIAL ANNOUNCEMENT.

The annual meeting of the American Forestry Association will be held on the second Wednesday in December, being the thirteenth day, in the hall of the Cosmos Club, Washington, D. C.

With the issuance of the present number THE FORESTER closes the fifth year of its continuous publication. In its present form, with the support of a steadily increasing number of readers, the fact of its survival emphasizes the energy and enthusiasm of the founder of the paper, and his belief that the general adoption of forestry throughout the United States is one of the greatest safeguards which could be provided. In this connection it is interesting to recall a very unobtrusive comment in Baedeker, but one which has much food for thought:

"Of all the wooded districts of Germany, none present as beautiful and varied landscapes as the Black Forest; the heights are covered with fragrant Pine forests, while the valleys are fertile and well cultivated. In this prosperous district beggars are unknown."

The establishment of a "National Southern Park and Forest and Game Preserve" in Western North Carolina is receiving much favorable comment and support from the citizens of that and adjoining States. The dissemination of the

principles and ideas of forestry has brought about so much greater interest in the preservation of the forests that what was but lately the "fad" of the few, as it was sometimes termed, has now commanded the attention of the great body of the people.

Public sentiment has been formed with the gradual absorption of ideas on the practical value of forest protection. The people of North Carolina have come to understand that under present conditions the mountain and valley lands of the Southern Alleghenies will soon be denuded of their forests unless adequate legislation is obtained to regulate the cutting of timber and to secure protection against forest fires.

The attention of the South has been attracted to the strong efforts which will be made at the coming session of Congress for the enactment of laws to form a great National Park and Timber Reserve in Minnesota, Michigan is also seeking State and National legislation to protect what remains of the once magnificent forests of that State. Pennsylvania is urging the acquisition of large tracts of unproductive mountain land for forest reserves, and New York keeps in the forefront of the forest movement. In the closing month of the year there is much cause for encouragement from the general public awakening for forestry in the year of grace 1899.

CHIPS AND CLIPS.

It is a Bavarian maxim to plant a tree in every open space.

At the end of a prosperous year, "Logs is riz" is still the burden of the lumberman's song.

It is predicted that Gum will soon be as popular as Cottonwood in all branches of the package business.

A thousand dollars tariff was collected on a single cargo of Canadian Pine at Dunkirk, N. Y., recently.

The Transvaal War has spoiled the prospects of Pacific Coast exporters who were building up a considerable trade with South Africa.

Governor Scofield, of Wisconsin, has acquired large timber tracts in Idaho, to which State he will remove at the end of his official term.

The annual meeting of the Minnesota State Forestry Association will be held the first Tuesday in December, being the 5th prox, in Minneapolis.

A five-foot flood in the Susquehanna at Williamsport, Pa., has brought down many stranded logs, much to the lumberman's delight and profit.

A Wisconsin lumber company has entered into a contract with a Chicago firm disposing of its entire lumber cut for 1900, approximating fifty million feet.

The Division of Forestry of the U. S. Department of Agriculture has increased 400 per cent. in the numbers of its working force, during the past eighteen months.

Eight hundred and four thousand feet of lumber were turned out by a Minneapolis mill, in a regular run of eleven hours, beating the best previous record by 82,000 feet.

Apropos of the convening of Congress, it seems unfortunate that the genius who counts on utilizing sawdust commercially cannot join forces with the politicians who "saw wood."

The official report of exports of forest products from Canada during the past year shows a falling off of nearly one-sixth, the total export valuation being placed at twenty six and a half millions.

The camphor tree (*Laurus camphora*) is being planted as a street tree in New Orleans, La. A tree planted in 1883 in a four-inch pot is now 35 feet high and 52 inches in circumference at the butt.

Deciduous trees can be moved very easily at this season of the year. By digging a trench around the tree now, the change of location can be made without trouble at any time during the Winter.

The Manufacturers' Association of Brooklyn, N. Y., at its November meeting, approved the resolutions recently adopted by the State Commerce Convention on "The Preservation of Our State Forests."

The American record for a single cargo of lumber exported was broken a short time ago by the Norwegian steamer "Guernsey," which carried nearly three and one-half million feet out of Portland, Oregon.

The increasing use of wood for street paving purposes in England has attracted attention to the Jack Pine of Ontario. This is a heavier, stronger and denser wood than the Baltic or Norway timber, and its durability is said to be remarkable.

There is a strong suggestion of an acceptance of the principles of forestry in a Minneapolis lumberman's purchase of large tracts of California Sugar Pine. It is said he will hold them for his sons to develop, when they become of age.

A plan is under consideration for making use of water to develop 3,200 horse power for distribution to mines in the neighborhood of Cripple Creek, Col., the source of the water supply being Beaver Canyon. A steel rock dam will be built, having a storage capacity of 150,000,000 cubic feet.

The kingdom of Saxony, from its 430,000 acres of forest, mostly Spruce and mostly on poor mountain land, derives an annual net income of \$1,900,000, being \$4.50 per acre. This is being done without exhausting the forests; on the contrary, they are worth double to-day what they were forty years ago.

The former method of transporting logs from the forests in the northern part of Pennsylvania to the saw-mills in Williamsport by floating them down the river has been abandoned by one enterprising firm there on account of the uncertainty of the water supply in recent years. Hereafter the logs will be moved by rail.

In no part of the world are the forests more appreciated, probably, than in Central Africa, in the region inhabited by the tribe of pigmies discovered by Henry M. Stanley. These people, none of whom exceed four feet in height, never leave the forest under any circumstances. They are perfectly formed and fairly intelligent, but are timid and wary of strangers.

In the reconstruction of the Ontario Cabinet consequent upon the retirement of Hon. A. S. Hardy, Hon. J. M. Gibson, for four years in charge of the Crown Lands Department, has become Attorney-General. The new Commissioner of Crown Lands is Hon. E. J. Davis, lately Provincial Secretary, who is the head of one of the leading tanning firms of Canada.

A practice in vogue in France, Germany, Belgium and other European countries, is to plant fruit trees along the public roads. The local governments plant the trees and cultivate them as a source of revenue. In Belgium there are three-quarters of a mil-

lion roadside fruit trees, which in one year produced \$2,000,000 worth of fruit. The favorite trees for roadside planting are the Cherry, Plum, Apple, Chestnut and Walnut.

The Douglas Fir was named after David Douglas, a botanist who explored California in the first quarter of this century. It is distributed over a wide area from the coast to the summit of the Rocky Mountains. On the coast it attains the greatest proportions, specimens being sometimes found rising to a height of 300 feet with a circumference of 30 to 50 feet at the base. The ordinary average is, however, about 150 feet clear of limbs, with diameter of 5 or 6 feet at the base. The straight, clear stem, bare of branches almost to the top, makes the tree peculiarly valuable from a lumbering point of view.

A prominent English lumber manufacturer, Thomas J. Marone, after touring this country and Canada in quest of supplies, says:

"The people of this country fail to realize what the people of European countries have known to their sorrow for years—that the willful destruction of forests brings want in the end.

"Reforestation is now being practiced in all these older countries, but for fifty years to come Europe will have to look to America for the greater portion of her supply of lumber. Will America, with the destruction I see on every hand, be able to supply this demand even if we are willing to pay a good price?"

The far-reaching effects of forest destruction become more apparent day by day, sometimes in ways seldom thought of by the general public. An instance of this is the perturbation caused among beekeepers by the destruction of the Basswood forest, their anxiety for the future being shown in the following comment in an exchange:

"The problem is indeed a serious one; the States of New York, Pennsylvania, Michigan, Wisconsin and Minnesota, that have produced such large quantities of

basswood honey, will possibly in the future have to depend upon clover and other sources, and instead of ranking among the leading States for honey they may possibly in time drop down to second place. Already supply manufacturers are beginning to consider what material they will have to use for sections when Basswood is gone."

The Sportsman's Willow.

A gigantic Willow tree, which had been planted near the River Chelmer at Boreham, Essex, in England, in 1835, was cut down some time ago and has been found to weigh nearly 12 tons. It was 101 feet long, and 5¾ feet in diameter, a magnificent piece of willow. It is said that this one tree contained wood sufficient for making more than a thousand fine cricket bats.

Transplanting Carolina Poplars,

An attempt will shortly be made to transplant Carolina Poplars, a species of Cottonwood, in Pennsylvania. Timber of this species is said to make excellent wood pulp, and it is ready for cutting within fifteen years from the date of planting. Dr. J. T. Rothrock, Commissioner of Forestry, determined to make the experiment on a large body of land in Pike County which recently reverted to the State.

A Great Opportunity.

In connection with the valuable suggestions on the care and commercial culture of trees from the pen of Mr. Pinchot, it is pleasant to recall the words of Dr. Hale, of Boston, at the last annual meeting (the forty-second) of the first Village Improvement Society in America, the Laurel Hill Association of Stockbridge, Mass.

The preservation, enlargement and improvement of our forest domain was, he said, "the great opportunity and necessity of our country," though he prayed that forestry might be preserved from "those landscape gardeners who know better how to plant a garden than God in Eden." Its

forests, said Dr. Hale, had made America. It was sassafras and planks that had paid the Pilgrims' debt to their English creditors. It was a New Hampshire staff that had carried the admiral's flag into Santiago Bay. Yet many States derive nothing from their woodlands, and he wished that the States might use whatever surplus was at their disposal in making forests where now are deserts.

This is a measure that is greatly needed, or will be by the coming generation. Our resources are not inexhaustible. Indeed they are already within measurable distance of exhaustion. The laws that we have are inadequate. It may be noted that Germany, France and Switzerland are constantly adding to their forest preserves and that they make them the source of considerable revenue. No man or nation is rich enough to be a spendthrift.—*Churchman*, New York City.

Impressions of European Forestry.

An American tourist, cycling through Germany, has thus written of the roadside trees:

"These trees are either for shade purposes or are fruit trees, carefully tended, which produce a good revenue for the maintenance of the road. The Lombardy Poplar is the most striking of the first class and perhaps the most common; as these Poplars are so very slender they are planted close together and consequently with their great height furnish a fair shade except when the sun is directly over the road. Others of the shade trees are Elm, Linden, Beech and Horse Chestnut. One can ride for miles on the sunniest days and be constantly in total or partial shade; and this feature makes touring in the Summer months quite pleasant.

"The fruit trees, however, presented even greater features of interest, for they furnish not only an excellent shade, but also a fairly regular source of revenue. They belong to the 'Kreis,' or township, as we would say, and are as carefully tended as the trees in the best kept orchard. One's first thought on seeing them is—Will not the fruit be stolen by those going

along? The loss thus is, however, no greater than from private orchards along the roads; and there is, of course, a fine or imprisonment ready for the trespasser here, as there is in so many instances in this land of the 'Verboten.' When the fruit is well advanced towards ripeness an auction is held and the different sections of the roads are knocked down to the highest bidder. Thus the township receives a definite amount, and the purchaser sells the fruit for the highest price he can get."

The Coming of the Light.

It is a healthy sign that more and more attention is being paid to the question of forestry by the several State governments. We have very frequently in the past urged the vital importance of intelligent forestry, but, while regretting the absence of any widespread general interest or action, it has been fully realized that the best results to the nation would accrue, not from an effervescent though enthusiastic movement, but from a slower growth. It is essential for the best results that the urgent necessity be a deep-rooted conviction, which can only be developed as slow growth. The very fact that forestry is receiving serious attention after such a period of laxity may be looked upon as a healthy clause in the future of our national forests.

America is undoubtedly in a condition far ahead of that which confronted the governments of France, Germany, and the other European countries at the time when they turned their attention to the preservation of their forests; and with characteristic energy, when the present gentle awakening becomes a strong and hearty movement, the forests of America will be placed on a footing so far above that of the European forests as to surprise our own people. And, moreover, America, in this, as in so many other things, has the benefit of being able to learn what not to do from the errors of those countries which have gone before.

Our foresters will have to deal very largely with the reclaiming and management of the original forest land; it is not

merely a question of planting timber trees for profit. No country with a forest area anything like that of the United States is so poorly equipped for maintenance, and though the 30,000 acres of New York State devoted for the benefit of the entire nation is but a trifling area in proportion, still it is a step in the right direction.—*American Gardening.*

Arousing Popular Interest.

Several papers on forestry will be read at the Forty-second Annual Meeting of the Missouri State Horticultural Society, to be held in the Opera House, Princeton, Mo., December 5th, 6th and 7th. Among the papers will be:

"Forestry for Missouri, will it Pay?" by D. C. Burson, Kansas City, Mo.; "The Care and Management of Street Trees," by Prof. H. C. Irish, of the Missouri Botanical Garden, and Hermann Von Schrenk, of the U. S. Department of Agriculture; "Ornamental Trees," by H. R. Wayman, of Alvord, Mo.; "Why our Trees are Short-lived," by Prof. J. C. Whitten, of Columbia, Mo.

An Appreciation of Forestry.

Mr. Gifford Pinchot, chief forester of the government, has just issued *A Primer of Forestry*, being Bulletin 24, Division of Forestry, U. S. Department of Agriculture. It is well bound, beautifully and profusely illustrated, and contains a vast amount of valuable information for the public at large and especially for citizens of Oregon and Washington, where forest protection is becoming a pertinent question, and is receiving attention at the hands of men densely ignorant of the subject, as well as a few who are well informed. The author is probably the ablest forester on the American continent at the present time and this book is intended for the general public, consequently it is written in a popular manner and is free of scientific terms. Children of the schools should read it as well as business men, stockmen, lumbermen, professional men and all others interested in forests and forest protection.—*Oregon Native Son, Portland, Oregon.*

"Nothing of more practical value, in our opinion, has ever been issued from the government office than this Primer. The subject is of vital importance to the material welfare of the country, and the in-

formation given in this publication ought to be in the possession of every American citizen. It is an excellent and most satisfactory work."—*Leslie's Weekly*, New York.

Recent Publications.

The White Pine (*Pinus strobus* Linnæus)—By M. V. Spalding, Professor of Botany in the University of Michigan.

(REVISED AND ENLARGED BY B. E. FERNOW, WITH CONTRIBUTIONS BY F. H. CHITTENDEN AND FILIBERT ROTH. BULLETIN NO. 22 OF THE DIVISION OF FORESTRY.)

The present volume represents most careful investigations covering more than ten years, the first draft having been prepared as early as 1888, since which time it has undergone careful revision and received several important additions. As the title indicates, "The White Pine" is not, strictly speaking, the work of any one person. Professor Spalding, after the first writing, made several revisions, but was then forced from press of other work to abandon the completion of the study, which then fell to Dr. Fernow. Thirty pages out of the eighty-five, however, are definitely assigned to two of the contributors, while, in addition, the important subject of measurements in the field are accredited to Austin Gray and A. K. Młodziansky, the latter of whom also gave a portion of the material bearing upon the "rate of growth."

The monograph opens with a clear and fairly full account of the geographical distribution of *Pinus strobus*, followed by notes upon the character of its distribution by regions, with notes upon the boundaries of its distribution, and conclusions regarding its distribution in the virgin forest. In connection with this topic is a map showing the original distribution of the species, and half-tones showing the White Pine in mixture on tracts in New York State. The interesting topic of the history of the White Pine lumber industry is next taken up for a couple of pages, with some figures as to the yield of lumber from the Lake States from 1873 to 1897, and other figures. Passing then through the subject of original stand and present supplies, the natural history of the tree is reached. This, including the botanical description and observations on the morphological and histological characters, and on seeding, forms a decidedly valuable section.

As the object of the monograph is to supply the information necessary to the right utilization of the species, the topics already considered form properly a mere introduction to the discussion of the rate of growth and of the conditions of development, or the silvicultural characters of the White Pine. These latter considerations furnish the data upon which all

treatment of the tree as a forest crop will properly for the chief part depend. The matter of growth is treated consequently at some length, and the tables resulting will doubtless serve as a basis for working plans, when, in any instance, the special conditions of a specific region have also been studied and compared with these general statements. "Yield," the whole affair in a word, can then be treated with sufficient thoroughness.

This concludes the exposition of the White Pine under normal conditions, and gives place to the discussion of "dangers and diseases." On this subject F. H. Chittenden has contributed a valuable paper on "Insect Enemies of the White Pine." A discussion of the forest management of the tree here and in Germany follows, the monograph closing with a paper on the "Character and Physical Properties of the Wood," by Filibert Roth. An appendix contains numerous tables of measurements, and diagrams of growth.

In the United States, where much of the highly elaborated financial calculation deemed so essential in Germany is practically valueless at present, and is likely always to receive comparatively slight stress, it is the thorough knowledge of the silvicultural characters of any given species as well as the fact of growth which must underlie all the earlier stages of forest management. If this be true, the monograph under discussion deserves high praise. It adds very materially to our knowledge of the White Pine as a tree and as a member of a most important forest crop. It is to be regretted that this valuable data could not have been collected and put to use before so much waste had occurred through ignorance. Yet it is not too late to use it now, and there is every reason to hope that many owners of pine lands may apply to the care of a second crop the principles which were ignored in the harvesting of the first. The book, besides, will serve as a useful example for further work along similar lines. Admirable illustrations and diagrams form an important element in the work, adding much to its completeness.

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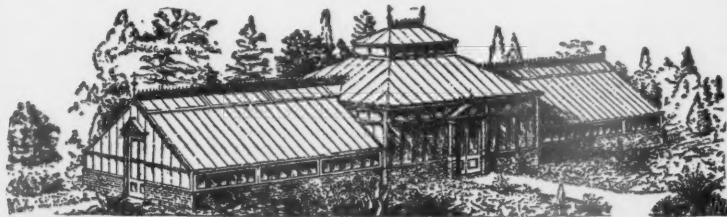
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